

## CLAIMS

1. A flue gas desulfurization system comprising:

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a) a scrubber section having an inlet and an outlet for said flue gas with a substantially horizontal flow path for said gas being defined between said inlet and outlet;

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b) scrubber composition spray means positioned in said horizontal gas flow path for spraying an aqueous scrubber composition in a direction which is generally cocurrent with said gas flow; said system being free of means which spray said scrubber composition in directions generally countercurrent to said gas flow

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c) a reaction tank underlying said scrubber section and in open communication therewith for providing a reservoir for said scrubber composition, for receiving the scrubber composition which has contacted said flue gas and gravitationally descended to said tank from said scrubber section, and for receiving the reaction products of said flue gas and scrubber composition;

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d) means for pumping the scrubber composition from said reaction tank to said spraying means;

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e) means for removing said reaction products from said reaction tank; and

f) means for replenishing the scrubber composition contained in said reaction tank.

- 30 2. A system in accordance with claim 1, further including means for introducing oxidation air into said reaction tank.

3. A system in accordance with claim 2 wherein said scrubber section comprises a primary and a secondary gas zone in series in the gas flow path, said zones being separated by a mist eliminator; said reaction tank being separated by a vertical partition into a secondary and a primary reaction section, which reaction sections respectively underlie and are in open communication with said primary and secondary gas zones; and wherein said pumping means comprises separate pumps for spraying aqueous scrubber composition from the secondary reaction tank into the primary gas zone and for spraying aqueous scrubber composition from the primary reaction section into the secondary gas zone

4. A system in accordance with claim 2, further including means to bleed aqueous scrubber composition from said primary reaction section to said secondary reaction section, and wherein said reaction products are removed from said secondary reaction section.

5. A system in accordance with claim 2, wherein said oxidation means is present only in said primary reaction section.

6. A system in accordance with claim 5, including agitation means for inhibiting settling of solids which are present in said secondary reaction section.

7. A system in accordance with claim 6, further including bleed means to bleed aqueous scrubber composition from said primary reaction section to said secondary reaction section.

8. A system in accordance with claim 7, wherein said bleed means is connected to wash the mist eliminator between said primary and secondary gas zones with said aqueous scrubber composition from said primary reaction section

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9. A method for desulfurizing flue gas comprising:

a) flowing said flue gas through a scrubber section having an inlet and an outlet for said flue gas with a horizontal flow path for said gas being defined between said inlet and outlet;

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b) contacting the flowing flue gas at said scrubber section with an aqueous scrubber composition by spraying the composition solely in a direction generally cocurrent with said gas flow;

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c) providing a reaction tank underlying said scrubber section as a reservoir for the scrubber composition and for collecting the scrubber composition which has contacted said flue gas and gravitationally descended to said tank, together with the reaction products of said flue gas and scrubber composition;

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d) utilizing the scrubber composition from said reaction tank in said spraying contact with said flue gas;

e) removing said reaction products from said reaction tank; and

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f) replenishing the scrubber composition contained in said reaction tank.

10. A method in accordance with claim 9, further including introducing oxidation air into said reaction tank.

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11. A method in accordance with claim 10, wherein said scrubber section includes a primary and a secondary gas zone in series in the gas flow path, said zones being separated by a mist eliminator; said reaction tank being separated by a vertical partition into a secondary and a primary reaction section which reaction sections respectively underlie and are in open communication with said primary and secondary gas zones; and wherein aqueous scrubber composition from the secondary reaction tank is sprayed into the primary gas zone and aqueous scrubber composition from the primary reaction section is sprayed into the secondary gas zone.

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12. A method in accordance with claim 11, wherein the scrubber composition is a limestone slurry and wherein reaction product is removed from said secondary reaction section; the pH in said secondary reaction section being sufficiently acid to dissolve calcium carbonate, whereby the gypsum product formed at said reaction tank from reaction of the scrubbing composition with sulfurous components of said flue gas can be withdrawn from said secondary reaction section relatively free of precipitated carbonates generated from reaction of the scrubbing composition with small quantities of carbon dioxide present in said flue gas.

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13. A method in accordance with claim 11, wherein the scrubber composition sprayed into said secondary gas zone is a limestone slurry and wherein a predominantly gypsum reaction product formed at said reaction tank from reaction of the scrubbing composition with sulfurous components of said flue gas is removed from said primary reaction section; the said oxidation air being introduced only into said primary reaction section, and the scrubber composition sprayed into said primary gas zone being primarily water, whereby hydrogen chloride and other acidic halogen gases contained in said flue gas are washed from said flue gas at said primary gas zone.

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14. A method in accordance with claim 13, further including agitating the contents of said secondary reaction section to inhibit settling of fly ash particulates which are derived from the incoming flue gas; and withdrawing of fly ash sludge from said secondary reaction section.

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15. A method in accordance with claim 11, wherein the scrubber composition sprayed into said secondary gas zone is a clear solution of ammonia, said oxidation air being introduced only into said primary reaction section, and wherein a solution of ammonium sulfate reaction product is pumped from said primary reaction tank and sprayed into said primary gas zone together with scrubber composition from said secondary reaction section; the flue gas flowing through said primary gas zone being quenched by the sprays to a sufficiently low temperature to enable the ammonium sulfate entering said secondary reaction section to crystalize; and withdrawing the crystalized ammonium sulfate reaction product from said secondary reaction section.

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